PRINTING CONTROL METHOD, PRINTING CONTROL DEVICE, MEDIUM HAVING PRINTING CONTROL PROGRAM RECORDED THEREIN, AND PRINTING APPARATUS

Patent number: JP2000233496

Publication date: 2000-08-29

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Classification:

- international: ***B41J2/01; B41J29/46; H04N1/23; H04N1/46; H04N1/60;*** **B41J2/01; B41J29/46; H04N1/23; H04N1/46; H04N1/60;** (IPC1-7): B41J2/01; B41J29/46; H04N1/23; H04N1/46; H04N1/60

- european:

Application number: JP19990036951 19990216

Priority number(s): JP19990036951 19990216

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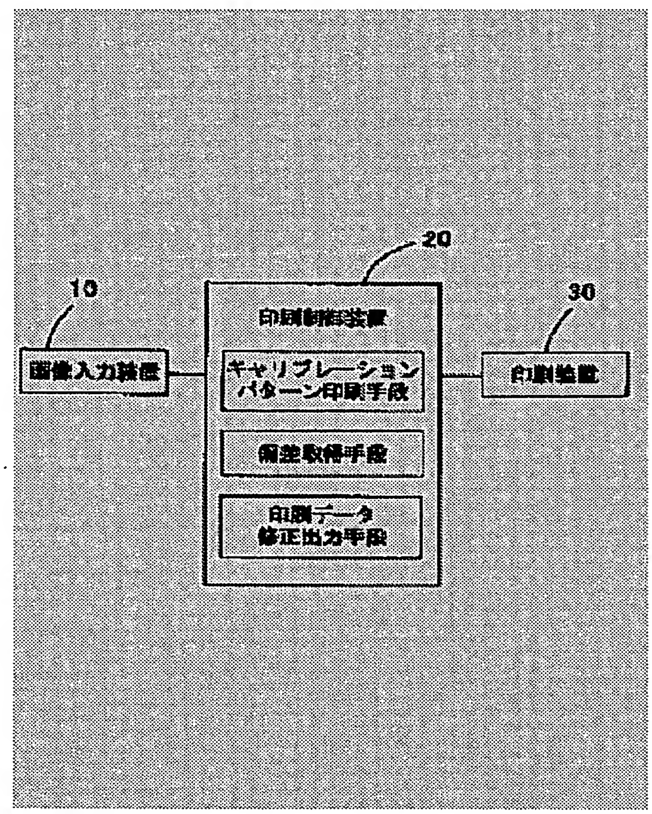
Abstract of **JP2000233496**

PROBLEM TO BE SOLVED: To prevent the occurrence of color shift caused by a variation of quantity of recording material to be affixed on a printing medium in accordance with printing position. SOLUTION: In printing apparatus 30, there comes about deflection between a color ink quantity planed in accordance with printing position and an actually affixed color ink quantity caused by differences and the like, so called, a platen gap, resulting in color shift depending on printing position; however, a printing control device 20 allows the printing apparatus 30 to print a predetermined calibration pattern so as to detect the aforementioned deflection depending on the printing position. In addition, deflection depending on a printing position is obtained on the basis of the calibration pattern; then correcting the printing data in a manner canceling the deflection. As such, color shift depending on the printing position can be solved.



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[0023]

[Advantage of the Invention]

As described above, according to the invention defined in claim 1, a color dislocation depending on printing positions can be grasped.

Further, according to the invention defined in claim 2, a prescribed calibration pattern is printed and the calibration pattern is used to obtain a deviation depending on the printing positions between a quantity of an expected recording material and a quantity of an actually used recording material and print data is corrected so as to cancel the deviation. Accordingly, a print control method can be provided by which the color dislocation depending on the printing positions can be cancelled. Further, according to the invention defined in claim 3, the calibration pattern may be printed correspondingly to printing positions respectively provided by finely dividing a printing medium for prescribed area units. Thus, a good maneuverability is achieved.

Further, according to the invention defined in claim 4, the calibration pattern is printed correspondingly to the printing positions respectively finely divided in a main scanning direction to obtain deviations respectively depending on the printing positions.

Accordingly, the color dislocation depending on the printing positions resulting from the difference of a platen gap generated in the main scanning direction is preferably cancelled.

[0024]

Further, according to the invention defined in claim 5, an example of the calibration pattern preferable when the deviation depending on the printing positions is obtained by a visual recognition of a user can be provided.

Further, according to the invention defined in claim 6, when a printing device is provided with independent printing heads respectively for element colors, the deviation of a quantity of a used recording material from a reference value is cancelled in each printing head. Accordingly, the deviation of color balance between the element colors can be cancelled.

Still further, according to the invention defined in claim 7, a print controller can be provided that can cancel the color dislocation depending on the printing positions can be likewise cancelled. According to the invention defined in claim 8, a medium in which a print control program is recorded can be provided.

Furthermore, according to the invention defined in claim 9, since the quantity of the recording material that is actually used is adjusted depending on the printing

positions to cancel the deviation depending on the printing positions, the printing device that can cancel the color dislocation depending on the printing positions can be provided.

[0025]

[Mode for Carrying Out the Invention]

Now, an embodiment of the present invention will be described below by referring to the drawings.

Fig. 1 shows a printing system to which a print control method according to one embodiment of the present invention is applied in a block diagram. Fig. 2 shows a structural example of specific hardware in a block diagram.

In the drawings, an image input device 10 inputs the color image data of a color image to a print controller 20. The print controller 20 performs a prescribed image process to the color image data to generate print data and outputs the print data to a printing device 30. Here, in the color image data, the color image is color separated for prescribed element colors to represent intensity respectively for the element colors. When even chromatic colors are mixed in the prescribed ratio, the chromatic color is composed of achromatic color such as gray and black.

[0026]

Here, as a specific example of the image input device 10, a scanner 11, a digital still camera 12 or a video camera 13 is exemplified. As a specific example of the print controller 20, a computer system including a computer 21, a hard disk 22, a keyboard 23, a CD-ROM drive 24, a floppy disk drive 25 and a modem 26 is exemplified. As a specific example of the printing device 30, a printer 31 is exemplified. The modem 26 is connected to a public communication line and connected to an external network through the public communication line so that software or data can be downloaded and introduced.

[0027]

The computer 21 is provided with a CPU 21a as a center of a calculating process, a ROM 21b in which programs incapable of being rewritten are recorded, a RAM 21c for ensuring a work area and a prescribed electronic device such as an I/O 21d so that the computer can suitably access an external device or execute the programs by suitably using these units. As a basic program of the programs, an operating system (OS) 21e operates. In the operating system 21e, incorporated are a printer driver (PRT DRV) 21f that allows the printer 31 to print and output data and a display driver (DSP DRV) 21g that allows a display 32 to display an image. The kinds of the drivers 21f and 21g depend on the types of the printer 31 or the display

32. The drivers can be respectively added or changed to the operating system 21e depending on their types of machines. Further, additional functions not lower than a standard process can be realized depending on the types of machines. That is, while a common processing system is maintained on a standard system of the operating system 21e, various kinds of additional processes can be realized within an allowable range. Further, an application (APL) 21h or the like is executed on the operating system 21e as the basic program and processed results are outputted from the printer 31 or the display 32 as described above.

[0028]

Fig. 3 shows a schematic structure of a color ink jet type printer 31. As printing ink, the printer employs six color inks including cyan (C), light cyan (c), magenta (M), light magenta (m), yellow (Y) and black (K) and is composed of six printing head units 31a1 having printing nozzles of one row. In such a way, since the printing head units 31a1 are respectively independent for the colors, an unevenness arises in output characteristics due to the difference of machine bodies respectively for the printing head units 31a1, so that a balance collapses between the inks.

[0029]

Each of the printing head units 31a1 is constructed

so as to discharge a very small color ink droplet by a micro-pump mechanism using a piezoelectric element that is distorted when prescribed driving voltage is applied thereto. The printer 31 includes, as well as a printing head 31a composed of the six printing head units 31a1, a printing head controller 31b for applying the driving voltage to the printing head 31a, a printing head shift motor 31c for moving the printing head 31a in a direction of digit, a sheet feed motor 31d for feeding a printing sheet in a direction of a line and a printer controller 31e as an interface to an external device in the printing head controller 31b, the printing head shift motor 31c and the sheet feed motor 31d.

[0030]

Fig. 4 shows a corresponding table of the weight of ink of a color ink used for one shot in each printing head unit 31a1 and a classification by the ID thereof. When IDs are merely called hereinafter, the weights of the inks of the IDs respectively corresponding to CcMmY are designated. As shown in Fig. 4, the range of the IDs is located from [1] to [21] and an intermediate value [11] is a reference value. In this case, the reference quantity of the weight of the ink used for one shot is desirably located within a range of 10.0 to 20.5 nano gram (ng). The reason of the above-described matter is

described below. In the case of the printer 31, the above-described color inks of CcMmY are used to print for RGB data employed in the computer 21. At this time, since color specification spaces are different, a color conversion is performed. Accordingly, in order to convert the color while the same color is held, the weight of the ink used for one shot in each of the printing head units 31a1 of CcMmY needs to be a constant prescribed value. When the quantities of use of the inks are different, this causes unevenness in output characteristics and a color balance to collapse.

[0031]

The difference of quantities of use of the inks in weight can be decreased, however, this causes the yield of production of the printing head units 31a1 to be deteriorated. Accordingly, a deviation between the above-described reference quantity and the weight of the ink in the actually specified ID is corrected in accordance with the state of data in the print controller 20, so that the deviation of the color balance can be cancelled. As apparent from the drawing, when the ID is smaller, the weight of the ink is large. Thus, a large quantity of color ink is used. Conversely, when the ID is larger, a small quantity of color ink is used. Accordingly, when the ID is large, if the density represented by data is

slightly increased, the deviation of the color balance between the color inks is corrected. On the contrary, when the ID is small, if the density is slightly decreased, the deviation can be similarly corrected. Therefore, a function converted between input data and output data correspondingly to the ID is previously prepared as shown in Fig. 5. When the data is converted in accordance with this function, the color balance can be held.

[0032]

The function shown in Fig. 5 is a well-known tone curve of a γ correction. When it is assumed that the RGB data has 256 gradations, a γ curve means an input and output relation of $Y = 255 \times (X/255) ** \gamma$ ("**" indicates a power). When γ is equal to 1, a correction is not carried out between an input and output, when γ is larger than 1, the output is weaker than the input and when γ is smaller than 1, the output is stronger than the input.

In this embodiment, the γ values of the tone curve in which printed results are most linear are previously obtained correspondingly to the IDs by an experiment and correcting look-up tables LUT1 to LUT21 respectively corresponding to the IDs are prepared. It is to be understood that the tone curve for correcting the deviation in accordance with a prescribed tendency while

a degree of correction is changed is not limited to the γ correction and other method such as a spline curve may be employed.

[0033]

When there is no unevenness in the weight of the ink used for one shot respectively in the printing head units 31a1, the deviation of the color balance does not arise. Under this state, the color of an original image is conscientiously reproduced. However, since the printer 31 in this embodiment can print an image on a large printing sheet of a size of "A1" or "A2" and has a large size as a device, a distance between the printing head unit 31a1 and the printing sheet, that is, a platen gap is different depending on printing positions owing to the problem of a production accuracy or a curve of a platen. Thus, a consideration may be directed to a phenomenon that the color dislocation arises depending on the printing positions. The platen gap has a close relation to a dot area of the color ink applied on the printing sheet. The correlation thereof is shown in a schematic view of Fig. 6.

[0034]

In the correlation shown in Fig. 6, the platen gap in design is "L (reference value)" and the dot area of the color ink on the printing sheet at this time is "S"

as previously determined. However, as described above, since the platen gap changes depending on the printing positions, the dot area of the color ink on the printing sheet changes as shown in the drawing. Specifically, when the platen gap is longer than the reference value, the dot area is liable to be decreased. When the platen gap is shorter than the reference value, the dot area is liable to be increased. It is to be understood that when the dot area is increased, the color is thicker than a predetermined color and when the dot area is decreased, the color is thinner than a predetermined color. In this meaning, the color dislocation arises depending on the printing positions.

[0035]

In this case, when the dot area is larger than a predetermined area, input data may be likewise corrected to be slightly thin and obtain output data. On the contrary, when the dot area is smaller than a predetermined dot area, input data may be similarly corrected to be slightly thick and obtain output data. Further, the input data may be likewise corrected by using the tone curve of the γ correction. Here, the deviation of the dot area mainly results from the difference of the platen gap, however, the deviation of the dot area may be considered to result from the difference of the weight of the ink

discharged for one shot. That is, assuming that the platen gap is fixed, when the weight of the ink used for one shot is large, the dot area of the color ink applied on the printing sheet is increased. Conversely, when the weight of the ink is small, the dot area is decreased.

Accordingly, to cancel the color dislocation depending on the printing positions as described above, a prescribed correcting look-up table may be selected from a plurality of correcting look-up tables that are previously prepared depending on the printing position and applied to correct the data. To cancel the deviation of the color balance, the data of an element color component in which the actual weight of the ink deviates from the reference value is corrected. As compared therewith, since the color dislocation depending on the printing positions is represented as the shade of color as a whole, that is, the difference of brightness, it is to be understood that the data of all element color components needs to be corrected.

[0036]

In this embodiment, the printing head units 31a1 are respectively allocated to the color inks of six colors. However, as shown in Fig. 7, the same printing head units 31a2 may be used to use the color inks of six colors. Further, as shown in Fig. 8, a unitary type printing head

unit 31a3 may be employed. In this case, in the unitary type printing head unit 31a3, a color dislocation is generated depending on printing positions, however, since the deviation of a quantity of use of ink does not basically arise respectively between the color inks, the deviation of a color balance does not arise. Further, the ink jet type color printer 31 is described above, however, to jet the color ink, not only the micro-pump mechanism by the piezo element, but also air bubbles may be generated by a heater provided on an inner side wall surface of an ink discharge port to jet the ink under the expansion pressure thereof. It is to be noted that the color ink may be jetted by other methods than the above-described methods. Otherwise, an electro-photographic system may be adopted that the color ink is not jetted and stuck by static electricity. In this case, quantities of toner applied on the printing sheet are different depending on the printing positions due to a factor such as the solid difference of individual drums so that the color dislocation may also arise.

[0037]

Further, in this embodiment, as the printing device 30, the printer 31 capable of performing a color printing is employed. The printing device may be applied to a facsimile device 33 shown in Fig. 9 or a color copying

machine 34 shown in Fig. 10. Namely, also in the color facsimile device 33 or the color copying machine 34, a deviation in the quantity of use of the color ink or the toner arises as in the printer 31 so that a color balance may collapse or a color dislocation may be generated depending on the printing positions. Further, in this embodiment, the computer system is used for correcting color image data relative to the printer 31. However, as shown in Fig. 11, such a color correcting system may be incorporated in a color printer 35 and color image data supplied form a network may be directly inputted and printed.

[0038]

As described above, when the color correcting system is incorporated in the printing device, a method for correcting the data is effective to cancel the deviation of the color balance. However, in order to cancel the color dislocation depending on the printing positions, the method for correcting the data itself is not necessarily effective. That is, if the shade of color is corrected as a whole depending on the printing positions, the driving voltage applied to the printing head may be dynamically changed depending on the printing positions to adjust the quantity of discharge of the ink. For instance, as shown in Fig. 12(a), assuming that the driving

voltage as a reference is "V", when the platen gap is longer than a reference value and the color appears as a slightly thin color, the driving voltage "VH" higher than "V" may be applied to the printing head to entirely increase the quantity of discharge of the ink for one shot as shown in Fig. 12(b). On the contrary, when the platen gap is shorter than the reference value and the color appears as a slightly thick color, the driving voltage "VL" lower than "V" may be applied to the printing head to entirely decrease the quantity of discharge of the ink for one shot as shown in Fig. 12(c).

[0039]

The computer 21 forming the print controller 20 in this embodiment includes a color balance adjusting program shown in a flowchart of Fig. 13 in the hard disk 22 so as to be executed as required. In Fig. 13, in step S110, a custom A pattern as a calibration pattern of a first stage is printed in the printer 31. As shown in Fig. 14, the color balance adjusting program in this embodiment recognizes a printing area on the printing sheet as areas R1, R2 and R3 obtained by equally dividing the printing area into three in a main scanning direction as a digit direction. In the step 110, the custom A pattern based on the same density data is printed respectively on the areas R1, R2 and R3 so as to be arranged in parallel

in the main scanning direction.

[0040]

Referring to Fig. 14, in a sub-scanning direction as a line direction of the areas R1, R2 and R3, it is understood that three patterns of custom B and C patterns and a custom D pattern are printed so as to be arranged in parallel in the main scanning direction in the same manner. Here, the custom B and C patterns or the custom D patterns are respectively based on the same density data and sequentially printed as described below. The patterns are respectively arranged and printed in the sub-scanning direction because of below-described reasons.

Since the printer 31 according to this embodiment prints the calibration patterns based on the same density data on the printing sheet of a large sheet size so as to be arranged in parallel in the main scanning direction, there are many printing areas that are not used for printing in the sub-scanning direction. Therefore, such printing areas are used to sequentially print the calibration patterns, so that space areas can be effectively used.

[0041]

Further, a meaning that the color balance adjusting program equally divides the printing area of the printing sheet in the main scanning direction is to detect whether

or not the color dislocation arises depending on the printing positions due to the difference of the platen gap as described above. Further, as is guessed, since while the printer 31 conveys the printing sheet in the sub-scanning direction, the printer moves the printing head units 31a1 in the main scanning direction to jet the color inks and print, the difference of the platen gap in the sub-scanning direction can be substantially neglected, and accordingly, an influence in the main scanning direction mainly obviously appears. In this embodiment, the printing area is equally divided into three in the main scanning direction, however, the printing area may be more finely divided and suitably changed.

[0042]

Each of the custom A pattern printed in the step S110 includes a custom A1 pattern and a custom A2 pattern printed in parallel with each other as shown in Fig. 15. Further, the custom A1 pattern includes circular gray patches "A1" to "D18" in which component data of cmY is different little by little as shown in Fig. 16. The custom A2 pattern includes circular gray patches "A1'" to "D18'" in which the component data of CMY is different little by little as shown in Fig. 17. In Figs. 16 and 17, the component data of cmY and CMY are respectively shown by %. In Figs.

18 and 19, the component data is respectively shown by tables.

[0043]

Referring to Fig. 16, the component data of cmY of the gray patches are respectively changed little by little in accordance with a prescribed regularity. In the gray patch "A1" in a center, the patch is originally seen to be achormatic color. As the patches go toward an upper part on a sheet, a red (R) component is increased. As the patches go toward a lower part on the sheet, the red component is decreased. Further, as the patches go downward in the left side, a green (G) component is increased. As the patches go upward in the right side, the green component is decreased. Further, as the patches go downward in the right side on the sheet, a blue(B) component is increased. As the patches go upward in the left side, the blue component is decreased.

Namely, an axis of coordinate of the red component as an element color is set in the direction directed upward and downward. An axis of coordinate of the green component as an element color is set in the direction directed to an obliquely upper part in the right side from an obliquely lower part in the left side. An axis of coordinate of the blue component as an element color is set in the direction directed to an obliquely upper

part in the left side from an obliquely lower part in the right side. The component data increases and decreases proportionally to coordinates determined by these axes of coordinates. Accordingly, in the custom A1 pattern, all sets are displayed in which the color balance of all the element colors is changed within a prescribed range. Further, in the custom A2 pattern, the component data is CMY and designed to show the same tendency as that of the custom A1 pattern.

[0044]

The custom A1 pattern shown in Fig. 16 includes the gray patch "A1" in the center, the patches "B1" to "B6" located by one turn outside the periphery of the patch "A1", the patches "C1" to "C12" located by one turn outside the periphery of the patches "B1" to "B6" and the patches "D1" to "D16" located in an outermost periphery. The patches are necessarily prevented from shifting outside the patches "C1" to "C12" under the check of hardware. Nevertheless, the patches "D1" to "D16" are printed from a below-described reason. Specifically, a fact is considered that a plurality of gray patches in which the component data deviates in accordance with a prescribed tendency when an achromatic color is selected are compared with the gray patches at both the sides thereof so that the gray patches can be precisely decided, and the gray

patches are necessarily allowed to be present at both the sides. It is to be understood that the above-described matter may be applied to the custom A2 patter shown in Fig. 17.

[0045]

When there is a deviation in the quantity of use of the ink respectively in the printing head units 31a1, a predetermined weight of ink is not discharged, a balance between the color inks is normal not in the gray patch "A1" or "A1'", but in other gray patches. That is, patches of achromatic color are obtained. An example of a corresponding relation obtained by inversely operating the relation is shown in Fig. 20. For instance, in the custom A2 pattern, when the gray patch "A1'" is seen to be an achromatic color, the ID of the quantity of use of the color ink of cyan indicates "11", the ID of the quantity of use of the color ink of magenta indicates "11" and the ID of the quantity of use of the color ink of yellow indicates "11". Accordingly, the quantities of use of the element colors are truly balanced. However, when the gray patch "C4'" is seen to be an achromatic color, as apparent from the figure, the ID of the quantity of use to the color ink of cyan indicates "11", the ID of the quantity of use to the color ink of magenta indicates "15" and the ID of the quantity of use to the color ink

of yellow indicates "7". That is, the weight of discharged ink is decreased a little by little in order of yellow, cyan and magenta. The intensity in actual quantity of discharge of ink between the element colors can be understood.

[0046]

When many gray patches are arranged in the custom A pattern, whether or not the patches have achromatic colors may be hardly decided. Therefore, as shown in Figs. 16 and 17, in the background of the gray patches, a reference patch of a transverse stripe pattern that has a prescribed brightness and hardly generates a difference in brightness between machine bodies or for printing positions is printed by a black ink, so that the background is compared with the gray patches to recognize and select the achromatic color. In this case, an accuracy can be improved when the achromatic patch is selected from the gray patches. In thee reference patch "REF 1" of the custom A1 pattern, the width of a line of a black line in the transverse stripe pattern is smaller than that of the reference patch "REF2" of the custom A2 pattern so that the brightness is matched with the gray patches entirely printed by light element color.

[0047]

When the custom A pattern is printed, a user is allowed to select marks of the gray patches that seem achromatic colors for the custom A1 pattern and the custom A2 pattern respectively in the areas R1, R2 and R3 and to input to the computer 21 from the keyboard 23 in step S120.

In a next step S130, the custom B and C patterns as the calibration patterns of a second stage are printed by using the marks of the gray patches inputted in the step S120. Since the printing sheet is delivered from the printer 31 after the custom A patterns are printed, which is not described above, the printing sheet is set on the printer 31 when the custom B and C patterns are printed. Then, on the assumption that the custom A patterns are printed on the printing sheet, the color balance adjusting program feeds the sheet by a prescribed quantity in the sub-scanning direction, and then, starts to print the custom B and C patterns. Thus, as shown in Fig. 14, the custom B and C patterns are printed in parallel in the main scanning direction below the three custom A patterns.

[0048]

The custom B and C patterns include, as shown in Fig. 21, a custom B pattern and a custom C pattern printed in parallel with each other. Further, the custom C pattern includes a custom C1 pattern and a custom C2 pattern.

Here, the custom B pattern includes, as shown in Fig. 22, a plurality of black patches "1" to "11" printed in the forms of long strips by a monotone pattern in which the density of the component data of black ink is different little by little and a reference patch "REF 1" of a transverse stripe pattern printed by the black ink in the background thereof. Numerical characters respectively described in the black patches "1" to "11" designate the component data of the black ink. The black patch "6" in the center is set as a reference. As the black patches go toward an upper part of the sheet, the density is decreased. As the black patches go toward a lower part, the density is increased.

[0049]

On the other hand, the custom C pattern and the custom C2 pattern are constructed as shown in Fig. 23. As apparent from Fig. 23, in this case, a plurality of long strip shaped patches are also printed. In this meaning, the custom C1 and C2 patterns are not different from the above-described custom B pattern. However, in the custom C1 pattern and the custom C2 pattern, the long strip shaped patches are respectively formed with gray patches "1" to "11", so that the custom C1 and C2 patterns are different from the custom B pattern.

That is, in the custom C1 pattern, in accordance with

the mark of the gray patch selected by the user in the custom A1 pattern respectively in the areas R1, R2 and R3, the gray patch "6" having the same brightness as that of the gray patch is arranged and the component data of cmY is respectively substantially equally changed and printed so that the density is decreased toward the upper part of the sheet surface and the density is increased toward the lower part. Further, in the background, the reference patch "REF 1" of the transverse stripe pattern is printed by the black ink.

[0050]

On the other hand, in the custom C2 pattern, in accordance with the mark of the gray patch selected by the user in the custom A2 pattern respectively in the areas R1, R2 and R3, the gray patch "6" having the same brightness as that of the gray patch is arranged and the component data of CMY is respectively substantially equally changed and printed so that the density is decreased toward the upper part of the sheet surface and the density is increased toward the lower part. Further, in the background, the reference patch "REF 2" of the transverse stripe pattern is printed by the black ink. Figs. 24 and 25 respectively show in tables the component data of the gray patches of the custom C1 pattern and the custom C2 pattern when the gray patches "B4" and "A1'"

are selected respectively in the custom A1 pattern and the custom A2 pattern. As apparent from these figures, the component data of cmY or CMY are respectively equally increased or decreased within a range of about ± 20 % by setting the gray patch "6" as a reference.

[0051]

When the above-described custom B and C patterns are printed, in the areas R1, R2 and R3 respectively, a user is allowed to select the mark of the black patch whose brightness corresponds to that of the background for the custom B pattern and select the marks of the gray patches whose brightness corresponds to those of the backgrounds for the custom C1 pattern and the custom C2 pattern and to input to the computer 21 from the keyboard 23 in step S140.

Here, when the platen gap in the main scanning direction is fixed, the gray patch of "6" as a reference is not necessarily selected. However, in the three areas R1, R2 and R3, the gray patches of the substantially same mark are selected, because the reference patch "REF1" or the reference patch "REF 2" of the transverse stripe pattern printed by the black ink in the backgrounds of the custom B and C patterns hardly generates the difference of brightness depending on the printing positions, so that the reference patch may be said to have a fixed

brightness in all the areas R1, R2 and R3. Accordingly, when the platen gap is fixed in the three areas R1, R2 ands R3, the shade of color deviates from a reference value as a whole, however, the shade of color is not generated between the areas.

[0052]

In a next step S150, the custom D patterns as the calibration patterns of a third stage are printed by using the marks of the gray patches inputted in the step S140. Also in this case, since the printing sheet is delivered from the printer 31 after the custom B and C patterns are printed, the printing sheet is set on the printer 31 when the custom D patterns are printed. Then, on the assumption that the custom A patterns and the custom B and C patterns are printed on the printing sheet, the color balance adjusting program feeds the sheet by a prescribed quantity in the sub-scanning direction, and then, starts to print the custom D patterns. Accordingly, as shown in Fig. 14, the custom D patterns are printed in parallel in the main scanning direction below the three custom B and C patterns.

[0053]

The custom D pattern includes, as shown in Fig. 15, a custom D1 pattern and a custom D2 pattern printed in parallel with each other. The custom D1 pattern and the

custom D2 pattern are respectively the same as the above-described custom A1 pattern and the custom A2 pattern in respect of a point that a plurality of gray patches "A1" to "D18" and "A1'" to "D18'" are printed. However, the component data of cmY or CMY in the gray patches are respectively different.

That is, in the custom D1 pattern and the D2 pattern, the gray patches "A1" and "A1'" are arranged that have the component data the same as that of the gray patches selected by the user in the custom C1 pattern and the custom C2 pattern in the areas R1, R2 and R3, respectively. Then, the component data is changed in accordance with the same regularity as that of the custom A1 pattern and the custom A2 pattern. A degree of change at this time is more decreased. For instance, Figs. 26 and 27 respectively show in tables the component data of the custom D1 pattern and the custom D2 pattern when the gray patches "6" and "3" are respectively selected in the custom C1 pattern and the custom C2 pattern. Here, when Fig. 18 is compared with Fig. 26, or Fig. 19 is compared with Fig. 27, it is apparently recognized that the degree of change of the component data between the gray patches shown in Figs. 26 and 27 is smaller than that shown in Figs. 18 and 19.

[0054]

When the custom D patterns are printed, the user is allowed to select marks of the gray patches seen to be achromatic colors from the custom D1 pattern and the custom D2 pattern respectively in the areas R1, R2 and R3 and to input the marks to the computer 21 from the keyboard 23 in step S160. In a next step 170, the correcting look-up table is determined in accordance with the IDs of K corresponding to the marks of the three black patches inputted in the step S140 and set to the printer driver 21f so as to be incorporated in a color converting look-up table used for converting color. Along therewith, the correcting look-up table is determined in accordance with the IDs of the colors of CcMmY corresponding to the marks of the six gray patches inputted in the step S160 and likewise set to the printer driver 21f. It is to be understood that the correcting look-up tables are set correspondingly to the three areas R1, R2 and R3.

[0055]

Fig. 28 shows a procedure of the printer driver 21f by a schematic flowchart. In Fig. 28, in step S210, rasterized print data is inputted, the look-up tables to be referred to correspondingly to the areas R1, R2 and R3 are switched to convert the color from the gradation data of RGB to the gradation data of CcMmY. At this time, after the color converting look-up table is referred to,

the correcting look-up table may be referred to for each of the components. In this case, when the contents of the color converting look-up table are previously rewritten by the contents of the correcting look-up table, the color converting look-up table is merely referred to so that the correction and a color conversion are performed at the same time.

[0056]

Namely, both when the correcting look-up table is referred to after the color converting look-up table is referred to, and when a rewritten color converting look-up table is referred to, the color conversion of step S210 is performed so that color image data loses the identity of color and is converted. However, though the identity of the color is lost, the color ink is jetted in the printing head in accordance with the data, original color can be reproduced due to the deviation of the quantity of use of the ink, and further, the color dislocation between the areas R1, R2 and R3 can be cancelled. Then, after the color is converted, in step 220, 256 gradations are binarized to 2 gradations. In step S230, a prescribed control code is added to form a spool file and the spool file is transferred to the printer 31 to perform a printing operation.

[0057]

As described above, in this embodiment, the first to the third calibration patterns are printed correspondingly to the areas R1, R2 and R3 in the steps S110, S130 and S150. A software structure and a hardware structure that perform such processes form a calibration pattern printing unit. Further, in the steps S120, S140 and S160, the user is allowed to select the patches, so that unevenness in the quantity of discharge of the ink respectively for the printing head units 31a1 and unevenness in the quantity of ink applied on the printing sheet depending on the printing positions are obtained. A software structure and a hardware structure that perform such processes form a deviation obtaining unit. Further, in the step S170, the correcting look-up tables are determined respectively for the areas R1, R2 and R3 in accordance with the selected results of the user and incorporated in the printer driver 21f. A software structure and a hardware structure that perform the above-described processes form a print data correcting and output unit.